



*Arab Academy for Science & Technology & Maritime Transport  
(AASTMT – Cairo Branch)*

*College of Engineering & technology*

*Electronics & Communication Engineering Department*

Course : Solid State Electronics

Course Code : EC210

Sheet #9

**TextBook**

'Principles of Electronic Materials and Devices', Third Edition, S.O. Kasap © McGraw-Hill, 2006

**Constants:**

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$$

$$\text{Charge of electron (q)} = 1.6 \times 10^{-19} \text{ C}$$

$$\text{Mass of electron (m}_e\text{)} = 9.1 \times 10^{-31} \text{ kg}$$

$$\text{Plank's Constant (h)} = 6.63 \times 10^{-34} \text{ Js}$$

$$\text{Boltzmann's Constant (k)} = 1.38 \times 10^{-23} \text{ JK}^{-1} = 8.617 \times 10^{-5} \text{ eVK}^{-1}$$

**Solve the following problems**

- [1] Plot the Fermi-Dirac distribution if Fermi-Level is located at 0.56 eV for T=0K,1000K.
- [2] Plot the Fermi-Dirac distribution for intrinsic silicon at T=1000K if  $E-E_f = \pm 0.3$ ,  $E-E_f = \pm 0.6$ .
- [3] For n-type silicon with  $E_{\text{Fermi}}$  below the conduction band with 0.2eV at T=200K.  
Use both the Fermi-Dirac and the Maxwell-Boltzmann distribution to calculate the probability of finding an electron at  $E_c$  (bottom of conduction band).
- [4] Given the effective density of states for conduction band and for valence band to be respectively,  $2.81 \times 10^{19} \text{ cm}^{-3}$  and  $1.16 \times 10^{19} \text{ cm}^{-3}$ , calculate the intrinsic concentration and the intrinsic resistivity of Si. The electron and hole drift mobilities are given at room temperature as  $1350$  and  $450 \text{ cm}^2 \text{V}^{-1} \text{ s}^{-1}$ .
- [5] For silicon at T=300K, given that the value of  $N_c = 2.8 \times 10^{19} \text{ cm}^{-3}$  and  $N_v = 1.04 \times 10^{19} \text{ cm}^{-3}$ , find:
  - a) The electron concentration for an n-type doped semiconductor if  $E_F$  is located at 146 meV below  $E_c$ .
  - b) The hole concentration for a p-type doped semiconductor if  $E_F$  is located at 0.31eV above  $E_v$ .